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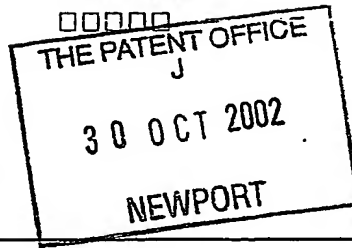
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30OCT02 E759591-1 D03008  
P01/7700 0.00-0225204.7

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Your reference

PHGB020181

Patent application number  
(The Patent Office will fill in this part)

0225204.7

30 OCT 2002

Full name, address and postcode of the or of each applicant (*underline all surnames*)

KONINKLIJKE PHILIPS ELECTRONICS N.V.  
GROENEWOUDSEWEG 1  
5621 BA EINDHOVEN  
THE NETHERLANDS

Patents ADP Number (*if you know it*)

7419294001

If the applicant is a corporate body, give the country/state of its incorporation

THE NETHERLANDS

Title of the invention

GPS RECEIVER

Name of your agent (*if you have one*)  
"Address for service" in the United Kingdom to which all correspondence should be sent (*including the postcode*)

Philips Intellectual Property and Standards  
Cross Oak Lane  
Redhill  
Surrey RH1 5HA  
08359655001

Patents ADP number (*if you know it*)

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Country

Priority Application number  
(*if you know it*)

Date of filing  
(*day/month/year*)

If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing  
(*day/month/year*)

Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer "Yes" if:

YES

- a) any applicant named in part 3 is not an inventor, or
  - b) there is an inventor who is not named as an applicant, or
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Description	4
Claims(s)	1 <i>2</i>
Abstract	1
Drawings	1 <i>2</i>

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Priority Documents

Translations of priority documents

Statement of inventorship and right

to grant of a patent (*Patents Form 7/77*)

Request for preliminary examination and

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(*Patents Form 10/77*)

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I/We request the grant of a patent on the basis of this application.

Signature *Stanswell* Date *29/10/2002*

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01293 815339

(S. Townsend)

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## DESCRIPTION

**GPS RECEIVER**

5           This invention relates to a GPS receiver having both an omnidirectional antenna and a directional antenna.

          US patent 5818389 discloses such a GPS receiver in which the directional antenna is primarily used for receiving signals from a possible  
10       source of interference, and in which both antennae in combination are used to determine the direction towards any such source. US patent 5818389 further indicates at lines 37 to 45 of column 9 that the GPS receiver may "acquire and track [GPS] satellites with the added gain of the directional antenna when most of the interfering signal is not in the directional beam and a substantial portion  
15       of the [GPS] signal is within the directional beam".

          It is an object of the invention to provide a GPS receiver having both an omnidirectional antenna and a directional antenna, and with improved ability to acquire weak GPS signals.

20

          In accordance with the present invention, there is provided such a GPS receiver configured to (i) acquire a first GPS signal from the output of the directional antenna, either alone or combined with the output of the omnidirectional antenna, and (ii) acquire a second GPS signal from the output  
25       of the omnidirectional antenna alone.

          The inventors have realised that whilst it can be desirable to use a relatively directional antenna to increase the chances of acquiring a weak GPS signal (as the maximum gain in the main lobe of a directional antenna is generally greater than that of a relatively omnidirectional antenna), an  
30       omnidirectional antenna will still be required to acquire satellites located in the directional antenna's nulls. Furthermore, the combining of the outputs of an omnidirectional antenna and a directional antenna as disclosed in US patent

5818389 reduces the signal to noise ratio for signals from those satellites located in the directional antenna's nulls whereby the only significant signal contribution for those satellites comes from the output of the omnidirectional antenna. By being able to acquire one signal from the directional antenna and  
5 another signal from the omnidirectional antenna alone, this disadvantage is avoided.

The second GPS signal and subsequent GPS signals may be acquired using assistance data obtained from the first GPS signal (such assistance data includes as almanac, ephemeris, frequency reference, Doppler and code  
10 phase information).

This is particularly useful in an environment where there is significant satellite obscuration. For example, a user of a handheld GPS receiver located indoors may direct the GPS receiver so that the main lobe of the directional antenna is directed to a window, thereby enabling the GPS receiver to acquire  
15 a first GPS signal from the output of the directional antenna by line of sight (or strong signal reflection) though the window. Then, with assistance data from the first GPS signal, the GPS receiver then has an increased chance of acquiring weaker signals, e.g. through walls, from the output of the omnidirectional antenna.

Conveniently, such a GPS is packaged for sale with instructions directing a user of the GPS receiver to point it in a direction (corresponding to a lobe of the directional antenna) from which a GPS signal is most likely to be acquired such as a window in an indoor environment or a gap between  
20 buildings in an urban canyon.

Also provided in accordance with the present invention is a GPS receiver having an omnidirectional antenna and a directional antenna characterised by the GPS receiver being configured to acquire a GPS signal from the output of the directional antenna alone.  
25

The present invention will now be described, by way of example only, with reference to the accompanying schematic drawing in which:  
30

Figure 1 shows a GPS receiver in accordance with the present

invention.

It is well known to provide a GPS receiver in which replica GPS satellite pseudorandom noise (PRN) code signals are continuous generated and correlated with received GPS signals in order to acquire them. Typically, as the replica codes are likely to have a different code phase to those of the received GPS signals and also a different frequency due to Doppler shift between the receiver and orbiting satellites, a two dimensional code frequency / phase sweep is employed whereby such a sweep will eventually result in the incoming PRN code having the same frequency and code phase as that of the locally generated replica. If detected, the code is acquired and tracked, and the pseudorange information may be retrieved from which the position of the receiver may be calculated using conventional navigation algorithms.

Such a GPS receiver 1 is shown, schematically, in figure 1 having both an omnidirectional antenna 12 and a directional antenna 14, with corresponding receiver front ends 11, 13, all under the control of a GPS microprocessor 10 which is further responsible for processing the signals in parallel digital receiver channels (not shown) in a conventional manner.

The terms omnidirectional and directional are intended to be relative to each other in that the omnidirectional antenna has gain in most directions whereas the directional antenna has a more pronounced high gain, lobe in at least one direction but perhaps significant nulls in other directions. The design of such antennae to have a chosen frequency response range and lobe / gain pattern is entirely conventional.

In accordance with the present invention, the GPS receiver is able to acquire GPS signals as illustrated in the following example scenario:

#### Example

In an urban canyon, a GPS receiver tries and fails to acquire any one of a number of GPS signals it is attempting to simultaneously acquire using an output from the omnidirectional antenna. The GPS receiver informs the user of failure by way of an audible alert.

Suppose that the documentation supplied at sale with the GPS receiver states that in the event of such an alert, the user should point the GPS receiver towards a gap in such an urban canyon to increase the likelihood of signal acquisition.

5       After providing such an audible alert, the GPS receiver switches from using an output from the omnidirectional antenna to an output from the directional antenna, and the user points point the GPS receiver (and hence the directional antenna) towards a gap in the urban canyon. With the increased gain of the directional antenna (either alone or in combination with the output  
10 of the omnidirectional antenna), it is more likely to acquire a GPS signal (albeit in a limited field of view) and for the purpose of this illustration, let us suppose it does.

Having acquired one GPS signal using the output from the directional antenna, the GPS receiver can then listen to the ephemeris data message  
15 which describes the orbits of the satellites. In addition, the GPS receiver also has a reference frequency with which to resolve local oscillator errors and if the GPS receiver is in possession of a rough estimate of its current position based on a last known position (which does not have to be particularly accurate), the GPS receiver can speculate about the observed frequency of  
20 other GPS signals and also the code phase of their respective pseudorandom noise codes with which they are modulated.

The GPS receiver then attempts to acquire the remaining signals using an output from the omnidirectional antenna alone using assistance data from the GPS signal acquired using the directional antenna, and it does so with a  
25 much increased likelihood of being able to acquire the remaining signals.

## CLAIMS

1. A GPS receiver having an omnidirectional antenna and a  
5 directional antenna characterised by the GPS receiver being configured to:
- (i) acquire a first GPS signal from the output of the directional antenna,  
either alone or combined with the output of the omnidirectional antenna,  
and
  - (ii) acquire a second GPS signal from the output of the omnidirectional  
10 antenna alone.
2. A GPS receiver according to claim 1 wherein the second GPS  
signal is acquired using assistance data obtained from the first GPS signal.
3. A GPS receiver according to claim 1 packaged for sale with  
15 instructions directing a user of the GPS receiver to point the GPS receiver in a  
direction from which a GPS signal is most likely to be acquired.
4. A GPS receiver having an omnidirectional antenna and a  
20 directional antenna characterised by the GPS receiver being configured to  
acquire a GPS signal from the output of the directional antenna alone.



**ABSTRACT****GPS RECEIVER**

5        A GPS receiver is disclosed which has an omnidirectional antenna and  
a directional antenna and is configured to (i) acquire a first GPS signal from  
the output of the directional antenna, either alone or combined with the output  
of the omnidirectional antenna, and (ii) acquire a second GPS signal from the  
output of the omnidirectional antenna alone. Also, disclosed is a GPS receiver  
10    having an omnidirectional antenna and a directional antenna which is  
configured to acquire a GPS signal from the output of the directional antenna  
alone.

[figure 1]

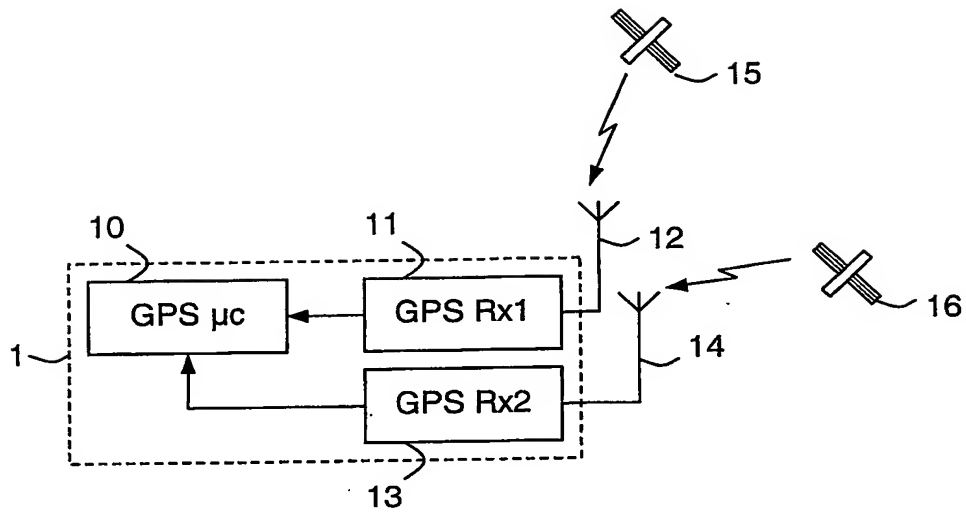


FIG. 1